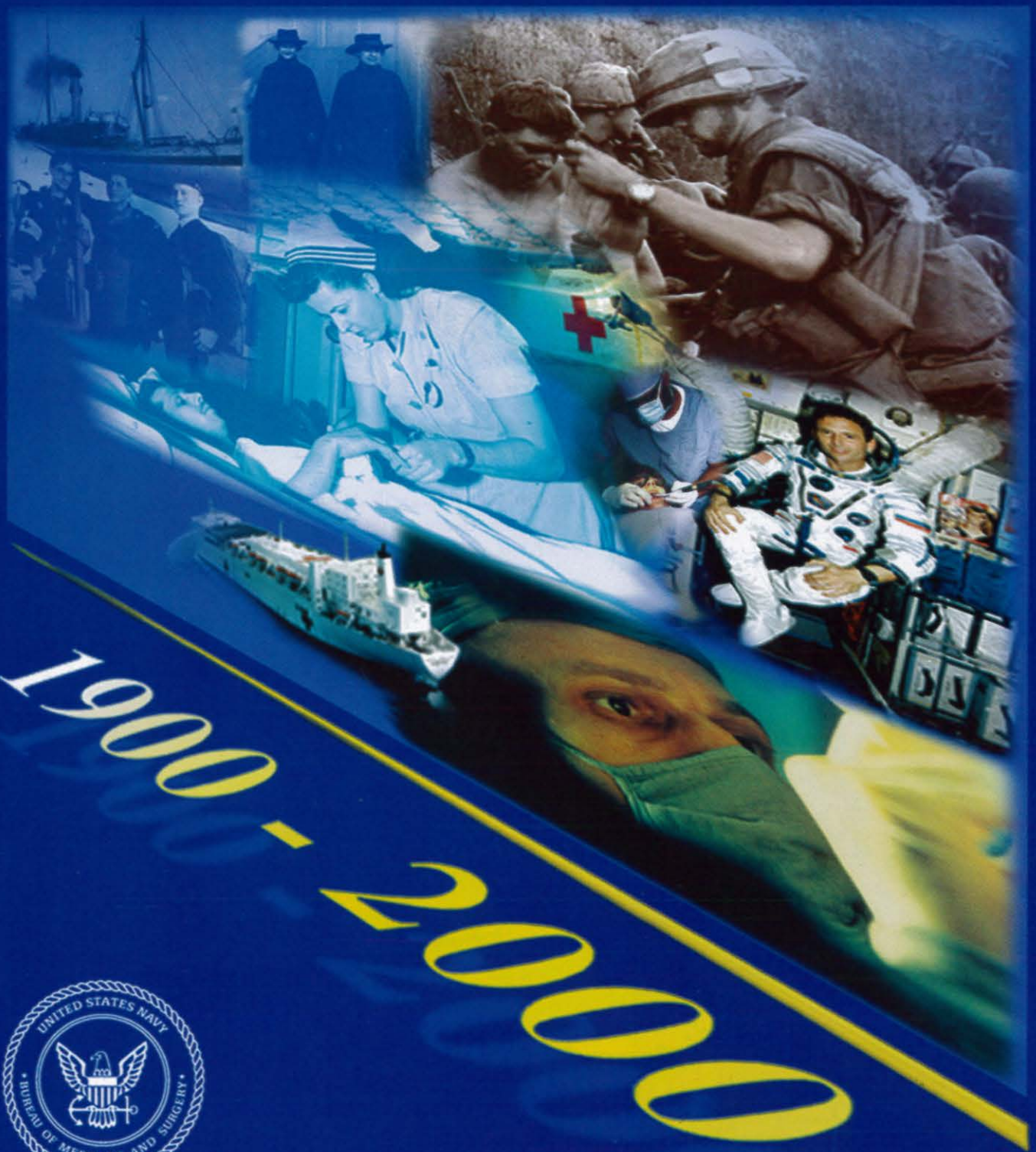
NAVY MEDICINE

January-February 2000



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COVER: During the past 100 years Navy medicine has grown with the mission and learned to adapt to many new and often exotic and hostile environments. A retrospective appears on page 14. Cover art by Sally Hobson, NSHS, Bethesda MD.

Feature

Cherry Point Medical Personnel Recognized for Hurricane Floyd Support

CAPT Bruce K. Bohnker, MC, USN
LTJG Gordon R. Blighton, MSC, USN

The torrential rains associated with Hurricane Floyd in September 1999 caused numerous rivers in eastern North Carolina to overflow their banks, isolating numerous residents of Rocky Mount, Tarboro, and Greenville in the rapidly rising flood waters. In response, the CH-46 search and rescue helicopters from MCAS Cherry Point, NC, were called out. The helicopters, referred to as "Pedro" for their radio call sign, were manned with Marines from Marine Transport Squadron One (VMR-1), Navy SAR corpsmen from Naval Hospital Cherry Point, and volunteer Navy flight surgeons from the Second Marine Aircraft Wing. The SAR corpsmen and flight surgeons provided limited advanced trauma/cardiac life support (ATLS/ACLS) to personnel rescued by the helicopters. During the 4-day period, the Marine helicopters rescued 399 people and delivered 14,655 pounds of cargo, while flying 50 sorties and logging 62.8 flight hours. Those rescued included two stranded boaters who were recovered by HM2 David Clipson after he rappeled from the helicopter through trees into the swirling flood waters.

Subsequently, Commander Marine Forces Atlantic awarded Air Medals for these actions to HM1 Robert Brown, USN, HM2 David Clipson, HM3 Richard Vollbrecht, and HM3 Mateo Benavidez from Naval Hospital Cherry Point. LCDR Mark Pressley MC, and LT Ralph Butler MC, from the Second Marine Aircraft Wing were similarly recognized. ❑

From left to right: HM1(FMF/NAC) Robert Brown, USN, HM2(FMF/NAC) David Clipson, HM3(FMF/NAC) Mateo Benavidez, and HM3(FMF/NAC) Richard Vollbrecht

Dr. Bohnker is Executive Officer, Naval Hospital Cherry Point, NC. LTJG Blighton is that facility's public affairs officer.

Medical Students Contribute to Research Efforts at Navy's Peru Laboratory

Peru, just south of the Equator, is a country of geographical diversity from the arid coastal desert to the snow-capped peaks of the Andes Mountains. The dense jungle of the Amazon Basin, which covers half of Peru, is globally recognized for its biodiversity—a species-rich area of tropical rain forests.

Peru draws tens of thousands of visitors each year. You can wander around colonial cities which have preserved the legacy of the Spanish conquistadors, visit the ancient Inca capital of Cuzco, explore the lost city of Machu Picchu, and study at one of the Navy's leading overseas medical research facilities. Lima, the cultural and business center of Peru, is an international city of 8 million people and home to the Naval Medical Research Center Detachment (NMRCD).

NMRCD conducts research aimed at minimizing the impact of infectious diseases on military operations, particularly in the Central and South American region. CDR Trueman Sharp, MC, officer in charge, points out why Navy medical researchers are in Peru, "The U.S. military faces the possibility of being deployed to many areas of the world, often on very short notice. Many of these potential trouble points harbor infectious diseases that can compromise military operations. The Southern Command area may appear to be relatively quiet geopolitically, but there are many U.S. national interests in South America, and there are a surprising number of U.S. military (personnel) operating in the region. The laboratory and field research we do in Peru confronts the challenges posed by indigenous infectious diseases head-on. Our primary goal is to conduct research that will help keep our military men and women healthy. We also collaborate closely with our host country and other South American countries to improve the health of the civilian population, particularly in emerging infectious diseases. We live in a global community; diseases do not recognize borders. Military medicine has an important role to play in fostering global health."

Douglas M. Watts, Ph.D., NMRCD Scientific Director, adds, "The goals of NMRCD are similar to the other Navy OCONUS laboratories in Egypt and Indonesia, but the research requirements differ because of the unique and diverse physical and biological features of this region. The types and prevalence of disease pathogens vary considerably. The variety of pathogens here, including representatives from every known complex of disease agents, presents unique opportunities for original research."

The student and postdoctoral training and research program was initiated by Dr. Watts. He said, "We wanted to provide a platform for U.S. students to train and conduct research on tropical diseases. In 1995, the first opportunity presented itself as part of a collaborative research agreement between the laboratory and Yale University. Yale was interested in conducting research at our field lab in Iquitos along the Amazon River on emerging arthropod-borne diseases, such as dengue and its mosquito vector, the *Aedes aegypti* mosquito. A Yale pre-med student turned out to be the first student in the program. Since then students from a variety of academic institutions have spent sum-

Rachel Sturke, who has a masters in public health from Columbia University, prepares a paper describing local emerging infectious diseases.

Naval Medical Research Center Detachment, Lima, Peru
Scientific Departments

Virology

From arboviruses such as Dengue, Venezuelan Equine Encephalitis, Oropouche Fever, and Mayaro Fever, to retroviruses such as HIV, the laboratory continues to evaluate the changing dynamics and epidemiology of these infectious diseases. This research leads to the diagnosis, prevention, and treatment methods for deployed forces.

Examples of Recent Achievements

- Documented the first cases of human disease associated with Mayaro and Group C arboviruses in Peru.
- Documented the largest outbreak of Yellow Fever ever recorded in Peru with a mortality rate of nearly 50 percent.
- Genotyped over 100 HIV specimens from various areas throughout Peru, Paraguay, and Uruguay. Only B genotype has been identified in Peru.
- Described the first cases of Venezuelan Equine Encephalitis among civilians and military troops in the Amazon region.
- Provided support to UNITAS deployments to South America.
- Documented the emergence of Dengue Fever as a major cause of morbidity in Peru. This includes the first outbreaks of Dengue-2 in the coastal and Amazon regions.
- Discovered the first hantaviruses and three other novel anthro-pod borne viruses in Peru.

Parasitology

Researchers capitalize on the resources and geographic diversity to identify and characterize parasitic diseases such as malaria and leishmaniasis, which present a threat to military operations throughout tropical regions around the world.

Examples of Recent Achievements

- Established epidemiological base and technologic capability to identify and define drug-resistant malaria isolates from sentinel areas.
- Phase II and III testing of diagnostic skin tests for leishmaniasis.
- Phase I and II testing of tropical therapy for leishmaniasis infection.
- Phase I and II trials of malaria vaccine.

Microbiology

Researchers focus on the endemic disease prevalence to identify and characterize bacterial diseases, focusing on enteric pathogens, which present a threat to military operations throughout the world.

Examples of Recent Achievements

- Demonstrated operational bacteriologic capabilities during UNITAS exercises in concurrence with active surveillance for enteric and sexually transmitted diseases.
- Conducted five rapid investigations of enteric disease outbreaks with analysis of etiologic agents and drug susceptibilities.
- Two collaborative studies sites for the evaluations of a vaccine to prevent recurrent *H. pylori* infection as a strategy to decrease the incidence of peptic ulcer disease.
- Epidemiological program to define diarrheal disease in Peru with specific surveillance for cholera, E. coli, and agents of viral gastroenteritis.
- Successful testing of a cholera vaccine including Phase I safety trials and Phase II/III testing.
- Identified *H. pylori* as a cause of gastrointestinal diseases in U.S. troops returning from Operation Desert Storm with followup studies to document mechanisms of pathogenesis, treatment resistance, and patterns of reinfection.

Entomology

Research monitor arthropod vectors and their habitats to characterize those vectors that present a threat to military operations throughout the tropical regions of the world.

Examples of Recent Achievements

- Completed a 3-year study to define the vector mosquitoes for Arboviral diseases in the Amazon region of Peru, more than 250,000 mosquitoes were collected and more than 30 Arboviruses isolates were identified.
- Established field sites for testing personal protective measures.
- Characterized the distribution, biting patterns, and infection rate for Anopheline vectors of *P. vivax* and *P. falciparum* in the Amazon region.
- Field-tested an innovative repellent, 30 percent DEET Face Paint. The camouflage product was as effective as the standard repellent and preserved infrared masking capabilities of the face paint.
- Field-tested a prototype bednet impregnated with permethrin. Results indicated superior protection.
- Identified 5 Culicoides species feeding on humans in the jungle and urban communities of the Amazon rain forest.

mers involved in research. They come from such places as the Uniformed Services University of the Health Sciences (USUHS); University of Wisconsin; University of Texas Medical Branch, Galveston; Stanford University; Vanderbilt University; University of Texas Southwestern Medical School; University of Toronto; Johns Hopkins University; University of Washington; University of Michigan; and Tulane University."

Each year NMRCD has hosted up to 10 medical, public health, and veterinary students. They study and train in a country where the incidence of infectious diseases is high. CDR Sharp feels it is essential to give military medical students the opportunity to work collaboratively with Peruvian scientists and physicians to learn about the research and medical infrastructure of the country.

CDR Sharp said, "I feel that part of our mission is serving as a platform for those in the military medical system to get research experience overseas. They need to see the diseases here and how these diseases are treated. Students can work side by side with Peruvian physicians who treat diseases like malaria every day. When the students go on to become hospital-based clinicians or operational medical officers these experiences will be invaluable."

From the beginning, a partnership is formed between the student, the student's academic advisor, and a NMRCD sponsor. Before a student's arrival, the team develops an individual training and study program for a short-term research project. Each student's project compliments current research efforts.

According to Dr. Watts, "These projects and other research training are carried out under the supervision of a sponsor and the technical staff. As an example, a lab project was conducted by a student to test anonymous human serum samples for an antibody as possible evidence of infection by a recently discovered virus. The virus was isolated from mosquitoes collected in the Amazon region. The results of this student's work provided the first evidence that this novel virus caused human infections."

The student who did the research was Alex Lemon, currently a second-year medical student at the University of Texas, Southwestern Medical School in Dallas, TX. Mr. Lemon's previous research experience focused on Venezuelan equine encephalitis while a student at the University of Texas, Galveston, where professors have collaborative arrangements with the laboratory in Peru. The work in Galveston fueled an interest in emerging infectious diseases and he arranged the trip to Peru.

For 2 months during the summer of 1999, Mr. Lemon worked closely with the research staff. He said, "One point of interest at NMRCD is the serum sample collection from patients who have had febrile illness in Iquitos. The collection dates back to the early 80's. My project was on a virus called Trocara. This virus is a close relative of viruses that cause significant disease in people. I did serological studies to find evidence of human infections by screening for human antibodies against the virus."

He went on to add, "My experience was fantastic. The medical school I go to is well known for its research. We have four Nobel laureates. Still, this type of research cannot be done here despite all the resources available. It was an interesting opportunity to go to Peru and work with people who make a career out of this type of medicine—research with an international focus. With the assistance of Dr. Watts, I wrote a paper I hope to present and have published."

The research experience is usually 1 to 4 months, with some postdoctoral research projects lasting for more than 1 year. For many students this is their first experience overseas. Most students spend the first week becoming familiar with the living and working environment which includes intensive training in biosafety, and if needed, in the application of basic laboratory techniques.

Each student is given hands-on experience in the various departments (microbiology, parasitology, entomology, and virology). At the main laboratory in Lima, students learn infectious disease diagnostic techniques. Clinical and epidemiological research training is centered at the NMRCD field site in Iquitos. Iquitos has a wealth of rivers, cloud forests, wildlife, and indigenous peoples.

Students doing fieldwork have the opportunity to build on their skills of epidemiological and clinical approaches using local resources and assets of the military health care system. CDR Sharp described one student's experience, "For one fourth-year medical student from USUHS, we designed a training scenario based on a fictitious mission of Marines deploying to the Amazon basin for jungle training. She

Alex Lemon tests serum samples collected from patients with febrile illnesses.

was the senior medical officer and needed to do a health threat assessment of the region and make recommendations to prevent, then treat, diseases she expected to see in the Marines. She had to determine what the larger implications were for the unit as a whole, which included an outbreak investigation. She was sent to Iquitos to visit the lab and the local hospitals to see real cases of disease—malaria, dengue fever, diarrheal diseases."

CAPT Larry Laughlin, MC, chairman of the Department of Preventive Medicine and Biometrics at USUHS, praised the relationship the university has with the lab. "The university has a very strong tropical medicine teaching component that fits in naturally with the Navy and Army overseas laboratories and we have a particular focus on the laboratory in Lima. We have a set of research protocols that are best carried out in Peru because of the disease we study, bartonellosis. Bartonellosis is a bacterium that invades red blood cells; much like the malaria parasite does, and causes extreme anemia and, if left untreated, can lead to death. This disease is transmitted by infected sand flies."

For 3 years CAPT Laughlin has led groups of medical students, graduate and doctoral students, and postdoctoral public health students into the mountains of Peru to the small village of Caraz for field studies. In his 24 years in the Navy, he has spent 17 years in the Navy's biomedical research community, 13 of those years in the OCONUS labs, and he described NMRCD, "This is a first-rate laboratory, with high caliber scientists using the best equipment and technology. The lab is absolutely invaluable, they have the connections with the political and public health infrastructure in the country and understand the subtleties of how to operate in another country."

What other research projects are available? CDR Sharp listed some potential research projects that students could focus on:

- Oropouche and dengue fever have recently emerged as major causes of human diseases, yet the epidemiology is poorly understood, especially the absence of dengue hemorrhagic fever, even though this severe form of dengue has been documented in neighboring countries.
- While evidence of hantaviral infection was demonstrated among rodents in the Amazon region, virtually nothing is known about the identity of these viruses and associated disease syndrome in humans.
- Observations on the epidemiology and treatment of leishmaniasis have revealed new species of Leishmania and clarified the efficacy of therapeutic drugs, yet further studies are needed to improve the diagnostic technology for these diseases, as well as more effective therapeutic drugs.
- Drug-resistant falciparum malaria has recently emerged as a major cause of human morbidity in Peru. Susceptibility to preventive and therapeutic drugs for malaria parasites is unknown and effective strategies for controlling arthropod vectors are not available.
- Enteric diseases are a major cause of human disease and offer numerous possibilities for evaluating novel therapeutic drugs and vaccines.

The laboratory currently supports a permanently assigned staff of 10 U.S. military and civilian scientists and technicians, and approximately 50 Peruvian staff. The American officers include two U.S. Army physicians and a Public Health Service physician from the Centers for Disease Control and Prevention. The staff conducts research on a variety of human pathogens in collaboration with local and international scientists. Current research is focused on the epidemiology of dengue fever, yellow fever, HIV genotypes, Oropouche fever, Mayoro virus, Venezuelan equine encephalitis, and hantaviruses. Researchers are evaluating malaria and dengue vaccines in animal models and in the field. The emergence of falciparum malaria and drug resistant malaria is a major issue under study. The reemergence of cholera in Peru in 1991, as the cause of a devastating epidemic, provided a unique opportunity to implement vaccine efficacy trials on enteric diseases among military and civilian volunteers.

The emergence of drug-resistant enteric pathogens is an important area of current investigation. Researchers are evaluating diagnostic tests for leishmaniasis, and studying the ecology and taxonomy of arthropod vectors. Several new species of phlebotomine sand fleas were recently recognized as potential vectors of Leishmania parasites. The prevalence of human T cell leukemia virus and associated diseases in Peru are among the highest in the world and a subject of current collaborative studies. Research in the past has focused on acute hepatitis associated with hepatitis B and a new genotype of hepatitis D virus that has become a major cause of morbidity among both children and adults.

CDR Sharp observed, "Taking the time to deal with students is sometimes difficult but we believe that it is part of our mission and very important. Besides, it is healthy for us. Students have a way of asking very difficult and challenging questions. They really keep us on our toes!" ❑

—Story by Doris M. Ryan, Medical Research and Development Division (MED-26), Bureau of Medicine and Surgery, Washington, DC.

Navy Researcher Awarded Highest Honor for Scientific Achievement

CAPT Stephen L. Hoffman, MC, USNR, received the *Captain Robert Dexter Conrad Award* for scientific achievement during a ceremony at the Office of Naval Research (ONR) in Washington, DC. CAPT Hoffman, director of the Malaria Research Program at the Naval Medical Research Center (NMRC), Forest Glen, MD, was recognized for his pioneering research on malaria vaccine development and the genetic sequencing of the malaria parasite, *Plasmodium falciparum*.

Although not seen as a serious public health problem in the United States, malaria is an internationally devastating disease. Malaria is found throughout the world in the tropics and subtropics, but has its greatest impact in sub-Saharan Africa. The disease infects about 300-500 million people each year according to the World Health Organization, and between one and 1.5 million people die each year. Most are children under the age of 5. Forty percent of the world's population is at risk of contracting the disease. Malaria is an enormous threat to military personnel deployed to the tropics and subtropics. In every military campaign during the past 100 years conducted in theaters where malaria was transmitted, the U.S. military had more casualties from malaria then from hostile fire.

CAPT Hoffman began his work on DNA-based vaccine development in 1992. In 1998, he and his colleagues published the first report that DNA vaccines were safe, well tolerated, and elicited an immune response in normal, healthy people. This work could lead to the development of other DNA-based vaccines used to battle a host of infectious diseases such as dengue, tuberculosis, and biological warfare threats.

Four years ago CAPT Hoffman set out to sequence the genome of *Plasmodium falciparum*, the parasite responsible for 99 percent of the world's deaths due to malaria, and the major cause of casualties in DOD operational forces. The parasite has a genome of 30 megabases and has an estimated 6,000 genes. The parasite's genome is 10-30 times larger than bacterial genomes that had been sequenced prior to his work. In 1998, his colleagues and he completed the genomic sequence of chromosome 2 of *P. falciparum*. This work provides the foundation for completing the genome in the next few years, and the blueprint for all research on this parasite for the next century.

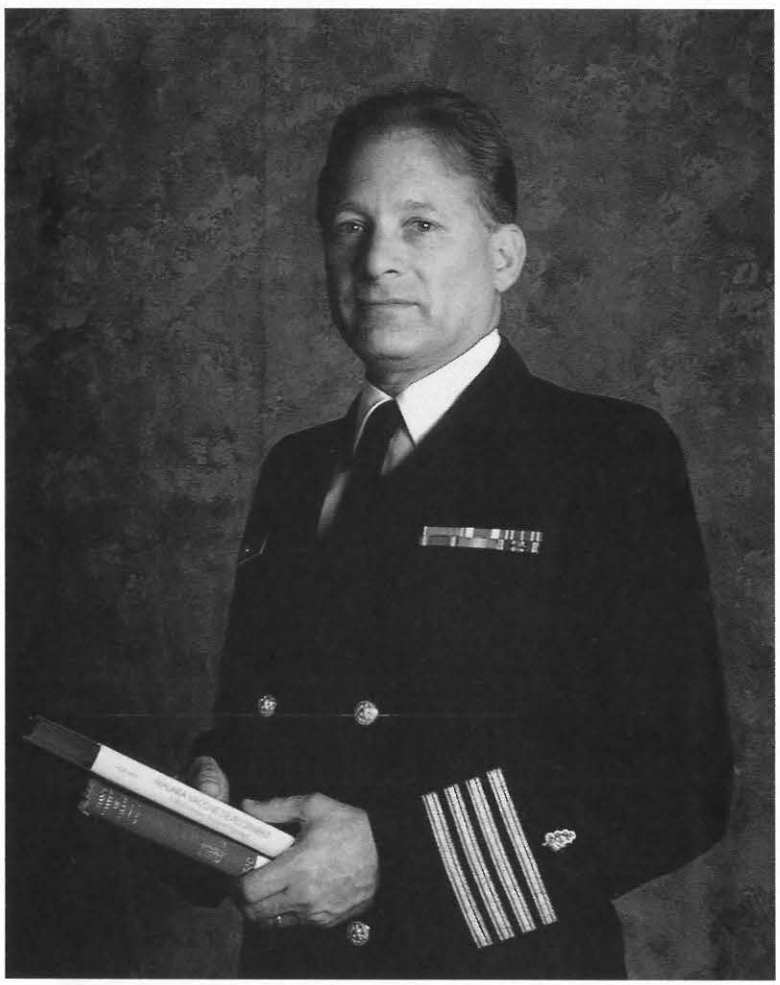
CAPT Hoffman leads a 55-member team of Medical Service Corps and Medical Corps officers, enlisted personnel and civilian researchers, and technicians whose collective expertise spans the breadth of biomedical science from molecular biology to field trials of vaccines and drugs. CAPT Hoffman is quick to acknowledge the work of his colleagues. At the ONR presentation ceremony, CAPT Hoffman said, "This award is really an award for the entire staff of the Malaria Programs at NMRC (Forest Glen, MD), NAMRU-2 (Jakarta, Indonesia), NAMRU-3 (Cairo, Egypt), and NMRC-Det (Lima, Peru), and all of our collaborators. It is because of the phenomenal work, dedication, and accomplishments of my

colleagues that I was selected for this award."

CAPT Hoffman also went on to recognize the contributions of other Navy medical researchers, who over the years laid the foundation on which he built his internationally known malaria program. He said, "The Navy has made incredible contributions in the treatment of tropical infectious diseases. One example is the treatment of cholera.

In the early 1980's, there was an editorial in the prestigious medical journal, *The Lancet*, suggesting that the greatest medical discovery of the 20th century was the development of oral rehydration solutions for treating cholera and other diarrheal diseases. In the early 1960's, CAPT Robert Phillips, then the commanding officer of NAMRU-2, received the Lasker Award, often considered the prize one receives before receiving the Nobel prize in medicine, for developing intravenous rehydration therapy for cholera. During the early 1960's, at NAMRU-2, CAPT Phillips first studied oral rehydration therapy. The Navy's research is in large part responsible for how the world now treats cholera. It was into this proud tradition that I stepped, and it is on that backdrop and with the same support that CAPT Phillips had, that my colleagues and I have been able to accomplish what we have in malaria research."

Looking back to his college days, when he was deciding on a career, CAPT Hoffman said, "Near the end of my junior year in college, which was spent abroad, I decided that I wanted a career that would allow me to do good for others, that would allow me to carry around my expertise in my head, and that would allow me to work anywhere in the world. I decided on medicine. I was a political philosophy major at the time, but I managed to take all the required courses during my senior year and went on to medical school. During my second year of medical school, I took a required course in tropical medicine given by a flamboyant professor named Ben Kean. I obtained a summer fellowship in Colombia, thanks to another professor, Walsh McDermott. By the end of the Colombian experience I was certain that I wanted to spend the rest of my life treating patients in a steamy hospital with ceiling fans, while wearing a white linen suit and a Panama hat and carrying a bottle of rum in my pocket. Seven years later, after finishing medical school, residency training, and a specialization in tropical medicine, I was on the faculty at the University of California at San Diego and running a tropical medicine and travelers' clinic. I was offered a number of positions, but only the Navy was willing to send me to the tropics to do clinical research on indigenous patients with tropical diseases."



CAPT Stephen L. Hoffman, MC, USNR

CAPT Hoffman spent 4 1/2 years at the Naval Medical Research Unit No. 2, in Jakarta, Indonesia, and the rest of his career at NMRC, where he currently coordinates malaria research activities at the Navy's laboratories in Indonesia, Peru, and Egypt as well as other overseas field locations. His efforts in improving chemoprophylaxis and treatment have reduced the impact of malaria on operational forces.

CAPT Hoffman points out, "We need a malaria vaccine to protect our

troops. For example, the Marines are often the first to land in a hostile situation so they have the highest risk of contracting malaria. We traditionally rely on antimalaria drugs to prevent malaria but frequently they do not work because the malaria parasites are resistant to the drugs or the drugs are not taken properly. We have never been deployed to the area of the world where malaria transmission is most intense which is sub-Saharan Africa. There the transmission intensity is 10 to 100 times greater than it was in the South Pacific or Vietnam. We believe, like all other infectious diseases, the best way to prevent the disease would be administering a vaccine. Researchers at the NMRC have been working for almost 30 years on this, and we are making slow incremental progress in regards to developing a vaccine to protect our personnel. Right now we are focusing on creating a vaccine that would be about 90 percent effective for 6 months."

CAPT Hoffman has created one of the world's leading malaria vaccine programs, which is internationally acclaimed as innovative in the pursuit of one of nature's most challenging biological problems. He has established associations with academia and private industry resulting in multiple cooperative research and development agreements and over 15 Navy initiated patent applications. These patents encompass the discovery of malaria proteins, methods of vaccinating against malaria, and methods for using genomic sequence data for vaccine development.

He went on to add, "During the last 20 years I have become increasingly mindful and respectful of the Navy's mission, and increasingly dedicated to ensuring that our personnel are protected from tropical infectious diseases. During all that time, the Navy has encouraged me to pursue the professional passion that was kindled during my second year of medical school, helping develop better ways of treating and preventing the tropical infectious diseases that place such a great toll on the health and well being of billions of inhabitants of our planet."

The *Captain Robert Dexter Conrad Award* for scientific achievement is named in honor of CAPT Conrad, who was a primary architect of the Navy's basic research program and the head of the Planning Division of the Office of Naval Research at the time of its establishment. The award is designed to recognize outstanding technical and scientific achievement in research and development for the Department of the Navy (DON) by either a private citizen employed by a DON contractor or grantee, or a government employee. The *Captain Robert Dexter Conrad Award* is granted, on an annual basis, to an individual who has made an outstanding contribution in the field of research and development for the DON. These contributions are widely recognized not only by the cognizant personnel within DON, but also by the civilian scientific and engineering community of the United States. The award consists of a gold medal and a certificate signed by the Secretary of the Navy.❑

—Story by Doris M. Ryan, Medical Research and Development Division (MED-26), Bureau of Medicine and Surgery, Washington, DC.

Retirement Notice

It is with sad hearts that we report that
Assistant Editor of *NAVY MEDICINE*,
Virginia M. Novinski,
retired on 17 December 1999, after 37 years of loyal and faithful service. We would like to thank her for a job well done and wish her many years of health, happiness, and one-tenth the amount of fun she has had working on this magazine.

The staff of *NAVY MEDICINE*
and the Navy Medical Department will miss her.

What Shall Replace the Hospital Ships?

LCDR Richard Guzman, MSC, USN
LT Youssef Aboul-Enein, MSC, USN

The article written by LCDR Pietro Marghella, MSC, in the December 1998 edition of *Naval Institute Proceedings* has caused considerable debate as to what is an adequate replacement for our two *Mercy* class hospital ships. Recognizing that replacing hospital ships within the next decade will need to be addressed, the author states that the *Newport* class LST-1179 tank landing ship would be a prime candidate for conversion.(*1*)

The L-class amphibious ship is a natural alternative, but the LST is too far left in the context of streamlined health service support. Although this class of ship is smaller, cheaper, and more versatile, the LST-1179 class amphibious ship cannot possibly replace the T-AH hospital ship in providing Echelon III care. The LST is also inadequate as a primary casualty receiving and treatment ship for providing Echelon II care. The LST's flat-bottom hull does not facilitate the practice of medical and surgical care while under way.

LCDR Marghella correctly addresses the issue of perilous patient movement throughout the passageways of our current hospital ships. However, the LST offers no significant improvement in litter transfer or eventual treatment.

In 2006, USNS *Comfort* (T-AH 20) and USNS *Mercy* (T-AH 19) will be nearly 20 years old.(*2*) The last LST, USS *Bristol County* (LST-1178), was decommissioned July 1994 and was sold to the Moroccan government. The only active LSTs are USS *La Moure County* (LST-1194) and USS *Frederick* (LST-1184) which are docked in Little Creek, VA, and Pearl Harbor, HI. Each of these ships is well over 30 years old.(*3*) Only eight LSTs remain in reserve throughout the United States with a few being considered for transfer to other nations.

LPH or LHA-Classes of Large Deck Amphibious Vessels

One viable alternative to the aging LST is a medically upgraded and refitted *Iwo Jima* class LPH or *Tarawa* class LHA. Larger than the LST, the LPH or LHA can offer more bed space, operating rooms, berthing, and the capability to land up to four or five CH-53 and CH-46 helicopters simultaneously as well as accommodate the new V-22 Osprey. The LPH or LHA will not be able to offer the 1,000-bed capacity of the hospital ship, but if outfitted can offer bed space close to that number. For the *Tarawa* class LHA, a well-deck can accommodate casualties and medical supplies arriving via LCAC (Landing Craft Air Cushion) or LCU (Landing Craft Unit), larger boats that move personnel and supplies from ship to shore. Additionally, the LPH and LHA are by doctrine designated Primary Casualty Receiving and Treatment Ships (PRCTS) in an Amphibious Task Force.(*4*)

Deploying a fleet of medically configured LST-1179s into an area of operation poses a command and control

problem complicating the afloat health care service support system. It may also be more costly to reconfigure several smaller LSTs versus investing in one or two larger deck amphibious ships of the LPH or LHA classes, which can accommodate more patients, medical staff, and equipment. Communications capability aboard the LHA and LPH are more advanced and vital for the control of patient movement.

Other advantages to the larger deck amphibious ships include:

Medical Personnel Familiarization: Navy medical professionals are currently being trained aboard larger deck amphibious ships. The Bureau of Medicine and Surgery is collaborating with naval hospitals, amphibious squadrons, and the Surface Warfare Medicine Institute to bring platform orientation to medical staffs who augment LHA and the even larger LHD *Wasp* class amphibious ships. This program started in 1998 with USS *Boxer* (LHD-4) and Naval Hospital Great Lakes and continues this year with two large deck amphibious ships scheduled to train augmenting hospital staff.(*5*) These larger deck amphibious ships are more familiar to the personnel of Navy medicine who have served aboard them as ship's company, or embarked staff like the Marine medical units and Fleet Surgical Teams. The same cannot be said of the smaller and older LST-1179s.

Stability: The hull construction of the smaller LST makes it more prone to high sea states and as such is affected by swells in the open sea. Since the LPHs and LHAs have 18,625 and 33,967 tons of displacement compared to 8,576 tons of the LST-1179, the larger ships are better suited for surgery as they offer a more stable platform.(*6*) One of the benefits of the hospital ships is that they were highly stable medical platforms displacing over 69,000 tons.

Decommissioning Dates: USS *Guam* (LPH-9) was the last LPH and was decommissioned in August 1998. USS *Tarawa* (LHA-1) and her four sister ships are all the LHA class ships that will be built by the Navy, having been replaced by the larger *Wasp* class LHD. The LHAs will all reach their 30-year lives between 2003 and 2008 and can be considered for conversion into a hospital ship capable of Echelon III care. Keep in mind that both hospital ships were converted *San Clemente* class tankers that were

USS *La Moure County* (LST-1194)

outfitted and upgraded in 1973 when the conversion work began on these tankers.(*6*)

Power Plants: Bringing medical technology onboard requires a robust engineering plant to generate the required power for all medical systems, communications, and the so called hotel steam needed for laundry, food, and other conveniences. A quick glance shows the disparity between the LST-1179 and larger LHA and LPH. The LST possess two steam shafts that generate 16,000 shaft horsepower (SHP) versus the LPH 23,000 SHP and LHA's 77,000 SHP. The hospital ships generate 24,500 SHP.(*6*)

Conclusion

The Navy found an alternative use for an LPH class ship with the USS *Tripoli*, now redesignated as a large minesweeping platform. The idea of a medically redesignated amphibious ship is a good one. However, the LST-1179 class ship is not the proper platform. We applaud LCDR Marghella's efforts to stimulate discussion of this topic and encourage those with shipboard experience to join the forum.

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USS *Guam* (LPH-9)

Uniform Requirements: Navy Nurse Corps 1925

In the 1920's the Uniform Regulations for the Nurse Corps changed to the following:

1. Uniform Regulations as herein revised supersede all other uniform regulations of the Navy Nurse Corps, and members of the Navy Nurse Corps are enjoined to provide themselves with the correct uniform, subsequent to the initial outfit, as laid down by these regulations, to conform to the principles set forth below and are forbidden to wear any other than the regulation uniform, insignia or devices of their respective rank and Corps, or any medals or orders in any other way than hereinafter prescribed, after the completion of their six months' probationary period and acceptance in the Corps.

2. Simplicity and cleanliness shall be the distinguishing marks of the uniform worn on duty, and members of the Nurse Corps are urged to take a special pride in their "Correctness, Neatness and Cleanliness in Uniform." Nurses are warned against purchasing cheap, thin material which will shrink and which will not wear well; and they are advised to exercise care and exactness in having their uniforms fitted and completed.

3. Nurses will be permitted to have four complete uniforms (which have been soiled on duty) in the laundry each week; with the exception of the Chief Nurses and operating room nurses, who may have more when emergencies require an additional number.

4. Nurses will be required to have their watches in order and the watch is to be regarded as a necessary part of the uniform to be worn always on duty.

5. Nurses will be required to arrange their hair neatly and as plainly as is consistent with a pleasing appearance. Bobbed hair is disapproved, as it does not lend to a dignified appearance. Those having bobbed hair will be required to wear it confined in a hairnet at all times to give the appearance of neatly dressed hair.

6. The cap may be altered in size to fit the individual head, but the general pattern and manner of wearing the cap must not be changed to suit the individual nurse. Unsightly pins, with protruding points, shall not be used to fasten the cap.

7. Fancy accessories, slippers, pumps, open work stockings, or a departure from plain footwear, shall not be worn on duty. Nurses will be required to have their shoes spotlessly clean and in good repair, avoiding run down heels.

8. With the exception of the insignia of the Corps, no jewelry, rings, fancy combs, chains, ribbons, or buckles shall be worn on duty.

9. The nurses shall not roll back the sleeves of their uniforms except when in the act of administering some unusual treatment which shall justify such action.

10. During cold weather the nurses shall be directed to wear underclothing of sufficient warmth, in order to avoid the necessity of additional outer garments, such as sweaters, capes, etc., while on duty in the hospital. Except in cases where open air treatment is prescribed, nurses shall not wear outer garments while performing duties of bedside nursing. Observing necessary precautions, the night nurses may be exceptions in this ruling.

11. Sachet powder, perfume, or any unguent having noticeable odor are prohibited.

12. Nurses detailed to special duty, night nurses, housekeepers, dietitians, etc., shall be required to observe, in toto, the same instructions with regard to uniform correctness.

13. Nurses not in uniform shall not be allowed into the hospitals without special permission from the Chief Nurse or her representative.

14. Nurses are forbidden to wear any part of the uniform dress with plain clothes, with the exception of the uniform cape, raincoat and sweater.

15. All articles of the prescribed uniform outfit may be purchased from the Officers' Uniform Shop, Navy Supply Depot, 29th Street & 3rd Avenue, South Brooklyn N.Y. Requisitions for supplies, other than the initial outfit, will be sent direct through the Commanding Officer of the station to which the nurse is attached. ❑

BUMED Archives

Nurses at the Washington Naval Hospital (now BUMED) model uniform cape and uniform sweater ca. 1920s.

The Last Hundred Years of Navy Medicine

It began as the tiniest cut, accidentally inflicted while stropping a straight razor during morning shaving rites. Replacing the skin on the end of his ring finger, the young man applied a bandage and paid no more attention to it for several days. A week later, even as the bandage was removed, he noted strange sensations and acute pain in all parts of his body. The following morning he awoke complaining of a stiffness in his jaws. Soon the muscles that controlled chewing began to lock. The invisible poison spread, attacking the arm and leg muscles and finally his diaphragm. Breathing became more difficult and now, even with his terrifying demise a certainty, the man's mind remained amazingly lucid; he was condemned to witness the inevitable last stages of his disease.

John Thoreau died of tetanus on 11 January 1842. That the brother of Henry David Thoreau succumbed to lockjaw was not unusual. Tetanus, the acute infectious disease caused by the tetanus bacillus toxin was a common and always fatal disease before scientists developed an antitoxin during World War I.

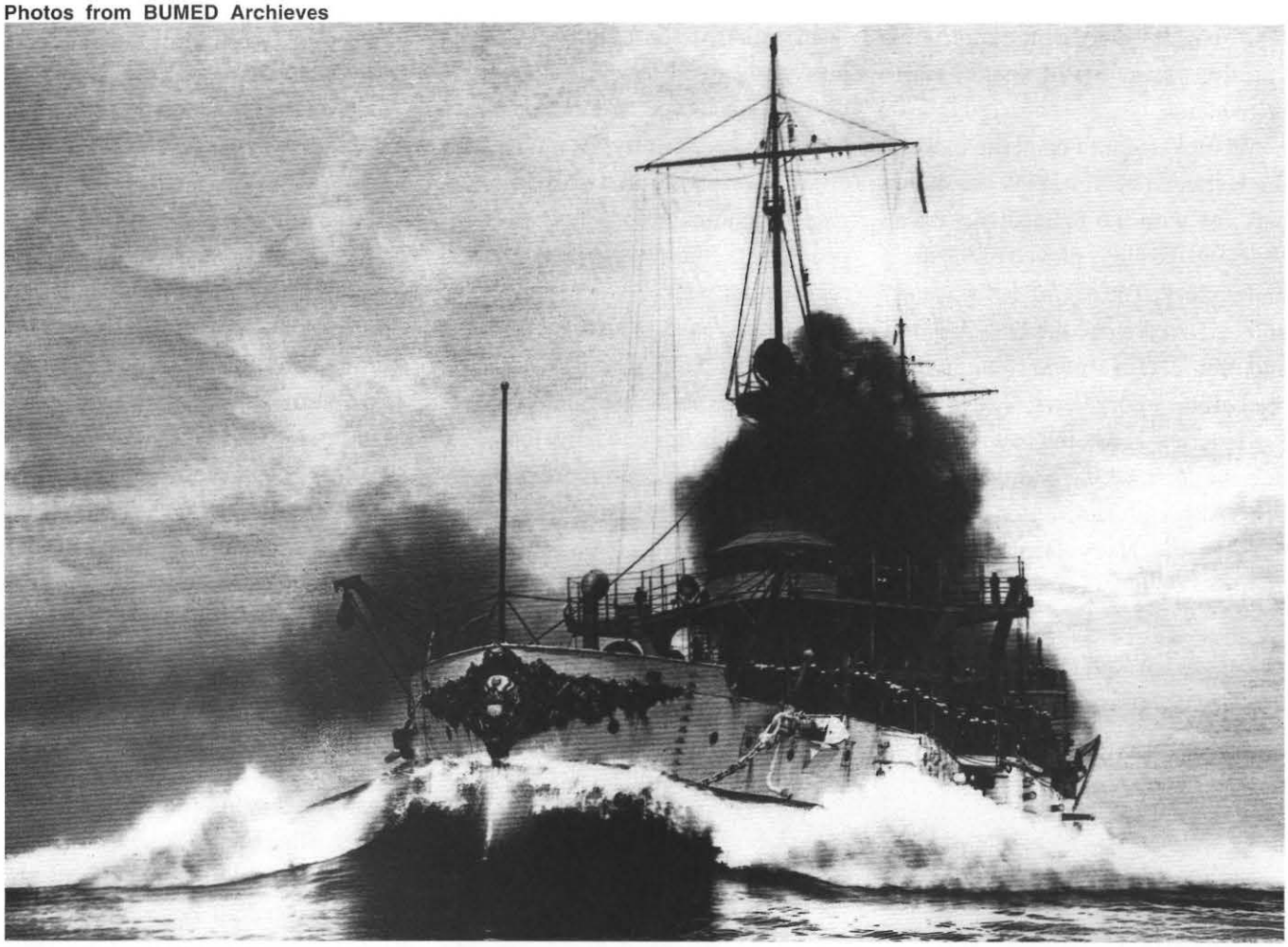
* * *

The face was sunken, as if wasted by lingering consumption; perfectly angular, and rendered particularly ghastly by the complete removal of all soft solids... the hands and feet were bluish white, wrinkled as when long macerated in cold water; the eyes had fallen to the bottom of their orbs, and evinced a glaring vitality... and the surface of the body was cold and bedewed with an early exudation...

This was a U.S. Army surgeon's terrifying description of a cholera victim in 1832. Cholera is a disease so virulent that after onset, the patient is usually dead in 1 or 2 days if left untreated.

* * *

Photos from BUMED Archieves



USS *Connecticut* (BB-18) steaming at high speed. A new all-steel Navy meant a new environment for Navy medicine (1907).

It was well into this century—1934—to be exact—that large-scale development of tetanus toxoid began in the United States. Indeed, the first experimental tetanus trials took place on the U.S. Navy hospital ship *Relief* that year. It was a Navy physician, CDR W.W. Hall who determined the proper interval between injections and the number of injections required for successful immunization. The scourge of lockjaw had been conquered.

And too, it was well into this century that a Navy physician developed a simple oral therapy that is now the standard cholera treatment throughout the world. CAPT Robert Phillips' therapy consisted of a formula rich in necessary salts and glucose that could be dissolved in water, and administered orally rather than intravenously. The cholera cocktail reduced the course of the disease to 6 hours and, with quick treatment, mortality was reduced to zero. Dr. Phillips' oral cocktail or slight variations of it are now available for the treatment of other enteric diseases in which dehydration is a serious problem.

I mention these cases because the legacy of Navy medicine is not well known and therefore not appreciated. Although the average citizen might admit that a highly specialized, battle-ready Navy requires a unique kind of medical support—hospital ships, fleet hospitals, flight surgeons, undersea medical officers, etc.—few would not be amazed at what Navy medicine has provided the health care field in general in the past hundred years.

Distilling Navy medicine's vast contributions of the last century into a brief article is a formidable task. Any one of its contributions could stand alone as a significant chapter in the history of medicine. Together, they

represent Navy medicine's continuing tradition of service to the nation and to humankind.

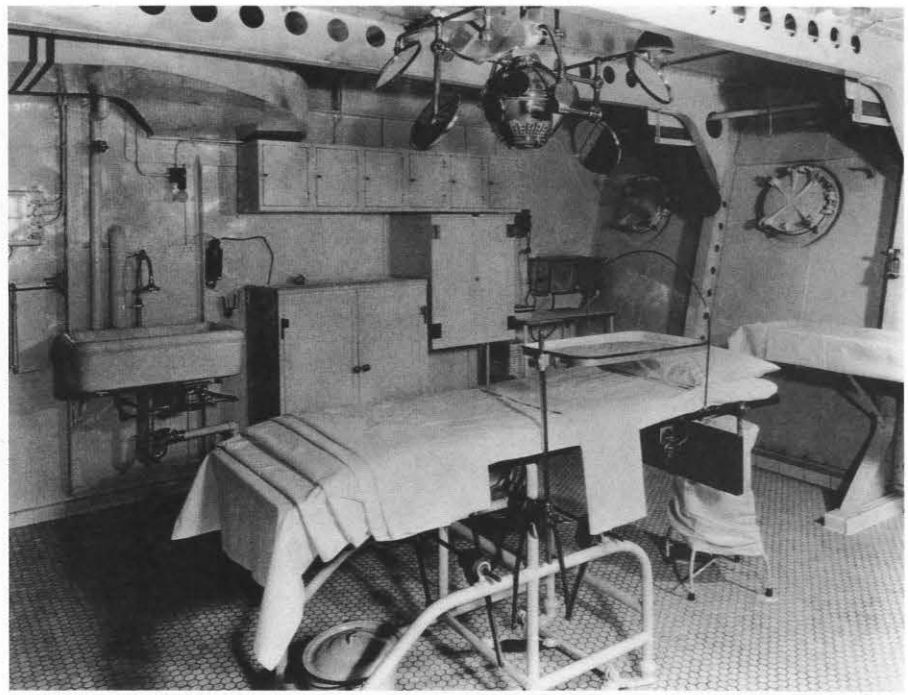
What was going on at the close of the last century? In 1899, the nation had just won the Spanish-American War, and the Navy played a big part in that victory. The age of sail was over and had been since the USS *Monitor* and the CSS *Virginia* fought their duel off Newport News, VA, in 1862. It was a new Navy and had been long in coming since the end of the Civil War. Although hard-bitten conservatives in the Navy Department had been loathe to trade traditional wooden hulls and canvas for an all-steel fleet, by the turn of the twentieth century that fact was a reality. And now with an all-steel Navy that was in many respects comparable to modern European fleets, there were new medical realities as well. As a result, Navy medicine was forced to confront a new way of doing business.

Navy medicine encountered new challenges heightened by that new environment. Steel ships propelled by steam meant hell-hot engine rooms where coal-heavers labored in temperatures sometimes approaching 130 degrees F. Ventilation in living spaces became a major concern as more and more sailors lived and worked in compartments sandwiched between unairconditioned multiple decks. Several years ago I discovered a dozen sets of blue prints in a basement at the Bureau of Medicine and Surgery. They were detailed plans of monitors, battleships, and destroyers dating to the turn of the century. Why were they at BUMED? Because these vessels required environmental retrofit. Hand drawn, intricate modifications in the ships' ventilation systems had been recommended by Medical Department personnel for shipboard livability and hygiene.

Indeed, there were other implications for the all-steel Navy. Modern naval gunnery now employed large caliber, rifled breach-loading artillery. What such weapons could inflict upon human flesh and bone had already been demonstrated in the Sino-Japanese War of 1895, the Spanish-American War, and the Russo-Japanese War of 1905. What had become commonplace were traumatic amputations, penetrating shrapnel wounds, flash-burns and horrific scald injuries caused by ruptured steam pipes and boilers—and the list could go on. How to move non-ambulatory casualties between decks, up ladders and through scuttles to sick bays and battle dressing stations required new techniques. It was at this time a future Surgeon General of the Navy, Charles F. Stokes, developed the litter that bears his name and is still used today.

World War I Navy nurse and two of her patients (1918).

But enough of injuries. Tropical disease was another concern. Let us not forget that the turn of this century put the nation on a new tack. Like the most powerful nations of Europe, we too became a colonial power. There were now the spoils of war to administer—Guam, the Philippines, Puerto Rico, Cuba, Samoa. The United States was now a Pacific naval power with new ships, new stations, and enlarged hospitals. Navy medical officers would be forced to confront tropical diseases few had ever seen before—dengue, yaws, leishmaniasis, leprosy, yellow fever, intermittent fever, filariasis, dysentery, elephantoid fever, and malaria, not to mention the ubiquitous venereal maladies sailors sometimes acquired in exotic liberty ports.



State-of-the-art operating room on a Navy battleship of the 1930's. Note the innovative operating lamp (1937).

One major way the Medical Department dealt with all these issues was training. In 1902 the Naval Medical School moved to Washington and was co-located in the old Naval Observatory with the Naval Museum of Hygiene. Its mission statement was simple and straightforward: the new school was "for the instruction and training of newly appointed medical officers in professional branches peculiar to naval requirements." Here was a place where newly commissioned physicians could learn the kind of medicine they would not have been exposed to in civilian medical schools—tropical medicine, the treatment of ballistic wounds, burns—in short, the grist of naval medicine. A 5-month course had a curriculum covering microscopy, naval hygiene, military surgery, military medicine, duties of the naval medical officer ashore and afloat, military law, and a program of physical exercise and military drill akin to what any student might experience in a military school or service academy.

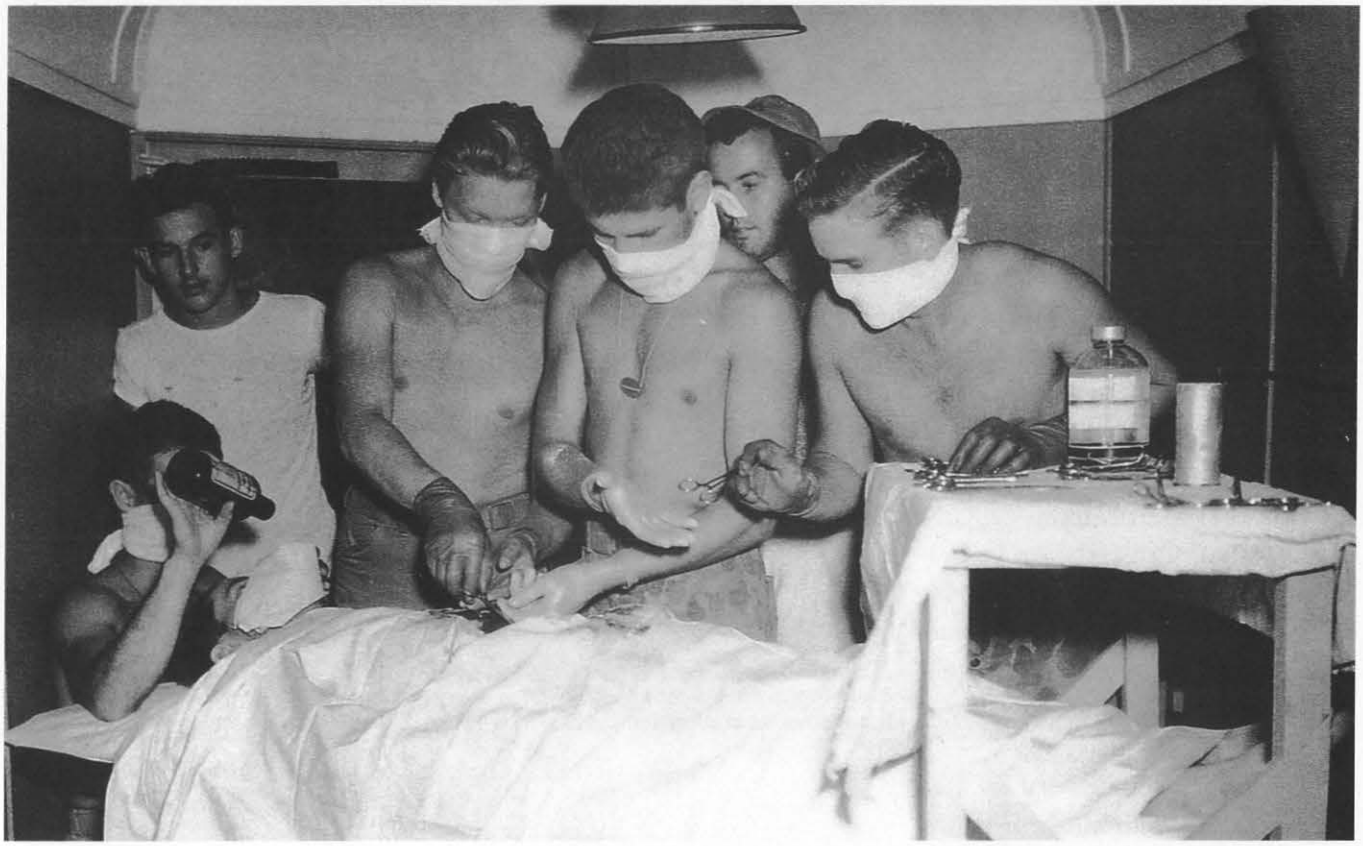
Because tropical disease had accounted for many of the casualties suffered in the recent war with Spain, tropical disease was a chief focus of attention at the school. Future Surgeon General of the Navy Edward Rhodes Stitt, now considered a pioneer in tropical medicine, taught at the school and was one of its commanding officers.

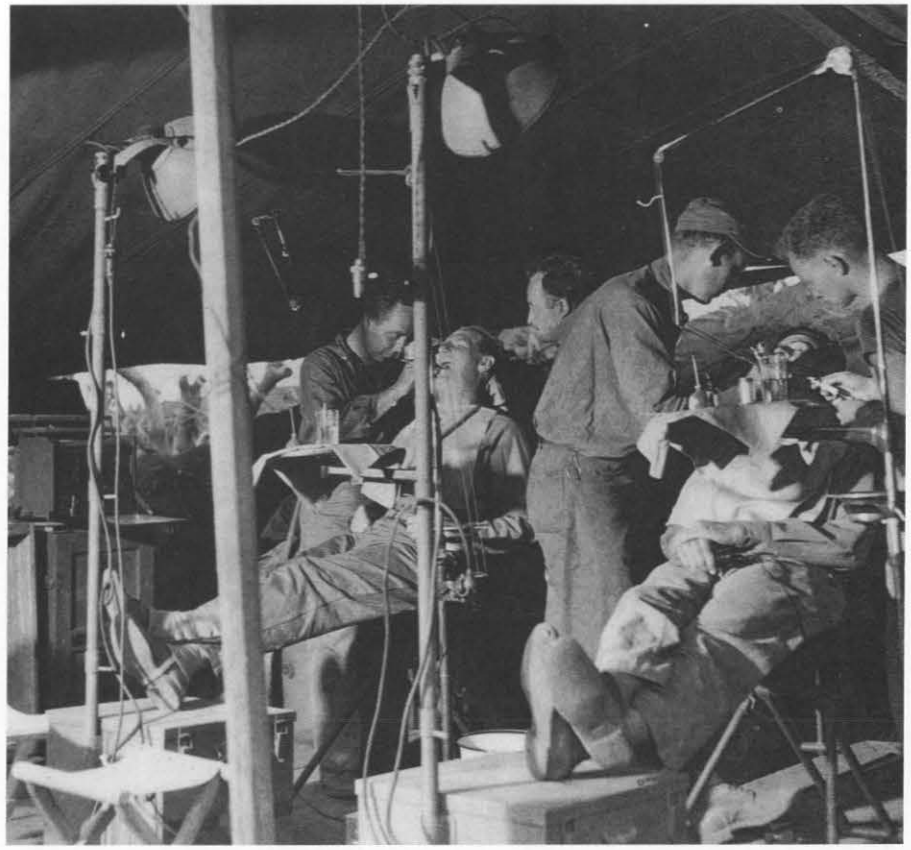
There were other significant developments in Navy medicine just before and just after the turn of the century. In the same year the United States fought the Spanish-American War in 1898, Congress passed legislation establishing the Hospital Corps. The first group of hospital corpsmen numbered but 25 pharmacists with the rank, pay, and privileges of warrant officers.

Following the creation of the Army Nurse Corps in 1902 by congressional act, BUMED campaigned for a similar corps for the Navy. That struggle finally paid off in 1908 with the establishment of the Navy Nurse Corps. The first group of nurses to report for duty has since been known as the "Sacred Twenty."

As with the Nurse Corps, there long had been the need for a professional corps for dental officers. In 1912 Congress finally authorized the Navy Dental Corps.

When the United States entered World War I in April of 1917, 38 physicians, 5 dentists, and 348 hospital corpsmen deployed to France. Nurses went as well. What they encountered were the frightful realities of trench





***Above*: As an anesthetist drips ether into an improvised gauze mask, a young surgeon and his assistants perform emergency surgery during World War II somewhere in the South Pacific (ca. 1943). *Right*: Even as the battle for Iwo Jima still rages, dentists and their assistants perform their duties in a field dental unit (1945).**

Preventive medicine: Hospital Corpsmen prepare hypodermic syringes as physicians administer tetanus and yellow fever shots aboard the USS *Nevada* enroute to Iwo Jima. As in previous wars, disease could keep more men off the line than enemy-inflicted injuries (1945).

warfare—a complete lack of the most rudimentary hygiene, and the terrifying results of mustard, phosgene, and chlorine gas. Seventeen corpsmen and a dentist were killed in action.

Those medical personnel who supported the Marine Brigade on the Western Front also had to deal with other war trauma—shrapnel, blast, high velocity projectile wounds, and psychiatric disorders then collectively known as shell-shock. From that terrible conflict in Europe, our medical personnel became skilled in trauma resuscitation, the treatment of wounds and infectious disease, and the psychological wounds of war.

What also came out of that war were two specialties—aviation and undersea medicine. Both fields should not have surprised anyone for the airplane and submarine were, for the first time, used extensively by the combatants. These new technologies kept many Navy medical personnel busy between the wars learning how to protect the human body in both hypobaric and hyperbaric environments.

The rapid expansion of the Navy and its Medical Department during the war quickly reversed itself in the 1920's. The Depression and renewed isolationism resulted in lean years for the Navy. Military budgets shrank under the Hoover administration and manpower dwindled. With reduced operations, warships either remained in port or were taken out of service. Nevertheless, Navy medicine prepared for future conflicts by developing base hospitals that could be moved and assembled on short notice, devising new systems of examining recruits, studying the latest advances in field sanitation, maintaining and training an adequate reserve of physicians, dentists, nurses, and hospital corpsmen for war, and supporting the Marine Corps.

The Fleet continued to conduct periodic but abbreviated exercises, and a fully equipped, modern hospital ship usually took part. Until the USS *Solace* joined the Pacific Fleet in the summer of 1941, the Navy's sole hospital ship, the USS *Relief*, took turns in both the Atlantic and Pacific.

Because the United States had traditional concerns in the Far East, American gunboats of the Yangtze Patrol cruised Chinese rivers safeguarding American missionaries and commercial interests. The Yangtze Patrol's blue-water parent organization, the Asiatic Fleet, maintained a token U.S. naval presence in far Pacific waters. However, by the mid-1930's its obsolescent ships were no match for a superior Japanese fleet that was increasingly becoming more aggressive.

Thoroughly traumatized after losing a whole generation of young men in the trenches of World War I, France and Britain embraced the hazardous policy of appeasement. In Europe and

Anchored in Inchon Harbor, South Korea, the hospital ship USS *Haven* displays an innovative approach to the receipt of helicopter-borne casualties. The two floating platforms would eventually be replaced by a helo deck on the ship's fantail (1951).

Asia fascism and imperialism marched unopposed. What happened on 7 Dec 1941 changed the very nature of Navy medicine as an institution.

As Pearl Harbor galvanized an unprepared nation into action, so too did Navy medicine respond to the challenge of world war. In 1941, the Navy had but 18 continental hospitals, three overseas hospitals, two mobile hospitals, and two hospital ships in commission. Approximately 13,500 physicians, dentists, nurses, hospital corps officers, and corpsmen—pharmacist's mates as they were then called—manned these facilities. In contrast, by 1945, the ranks had swollen to about 169,000 personnel, a staggering growth of 1,252 percent! They were assigned to 56 stateside hospitals, 12 fleet hospitals, 16 base hospitals, 14 convalescent hospitals, 15 hospital ships, 5 special augmented hospitals, and many dispensaries.

Navy medical personnel supported the fleet and Marine Corps in all theaters but most prominently in the Pacific. What they accomplished in that war and what advances in medicine came about are much too detailed to present here. Suffice it to say that the recruitment of well trained providers and the proliferation of mobile and base hospitals and hospital ships greatly improved the survival rate. Moreover, the use of plasma, serum albumin, whole blood, sulfa, penicillin, and air evacuation are worth mentioning in passing.

When it was over in 1945, the rapidity of demobilization was dizzying. By June of 1950, the armed forces were ill-prepared to cope with what happened on the 25th of that month when North Korean forces poured across the 38th Parallel. How the Navy Medical Department cobbled together a strategy to support the Marines in a land of fire and ice will be the subject of articles in *Navy Medicine* during the upcoming 50th anniversary of the Korean War. What can be mentioned now is that the three hospital ships that went to Korea did yeoman duty. And for the first time, helicopters could land aboard the USS *Consolation* bringing wounded to definitive care shortly after they had incurred their injuries.

The war in Vietnam that consumed most of the 1960s and the first 3 years of the '70s saw further refinement of airevac and surgical techniques, especially aboard USS *Repose* and USS *Sanctuary*, where surgical teams performed definitive surgery on patients who only minutes before had been in the field.

The Gulf War presented the opportunity to deploy our two new hospital ships USNS *Mercy* and USNS *Comfort* and the Fleet hospitals. We faced a new challenge, the threat of biological and chemical warfare. In addition to MOPP gear and gas masks donned in response to alarms, immunizations and prophylactic anti-nerve gas medication were additional tasks for providers. The ingenious work of the Forward Lab resulted in a historic dramatic reduction of diarrhea and enabled rapid return to duty.

But if what we primarily do is prepare for war—the term is readiness—Navy medicine continued to support "missions other than war." The race for space saw Navy medical participation in Projects Mercury, Gemini, Apollo, and post-lunar landing activities, such as the space shuttle missions. Indeed, it was a Navy flight surgeon—Joe Kerwin—who became the first American physician in space. Another, more recent member of our Navy medical community was CAPT Jerry Linenger, MC, who spent several months aboard the Russian Mir space station.

I would be remiss if I did not mention Navy medicine's critical participation in other crises around the globe—Beirut, Haiti, Somalia—humanitarian disasters from hurricanes to earthquakes—floods to droughts—shipwrecks to aircraft disasters. Navy medicine has been there with its SPRINT teams to handle the psychological trauma and with its highly trained hospital corpsmen, nurses, physicians dentists, and allied scientists to deal with disease and injury.

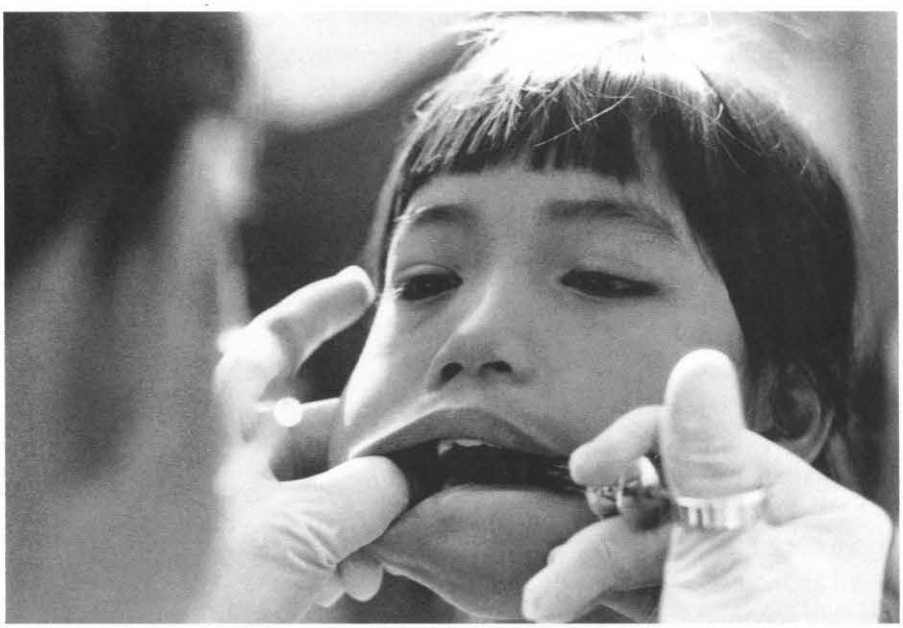
I would bring this article full circle by pointing out that even now, Navy

Aerospace Physiologist, CDR Elizabeth Reeves, MSC, monitors the recompression chamber at the submarine and diving section at the Naval Medical Research Institute (1960s).

***Above*: Helicopter evacuation in Vietnam (1966) *Opposite Top*: and during the Persian Gulf (1991).**

medicine's contributions are playing a key role in the recovery of EgyptAir Flight 990 off the coast of Nantucket. Even though the ill-fated aircraft's flight data and cockpit voice recorders have been recovered by a remotely controlled submersible, when and if on-site conditions improve, Navy divers will most probably be lowered 250 or so feet beneath the Atlantic to recover wreckage and human remains from the seabed. They will descend, work on the bottom, and then ascend using diving tables developed by Navy medical personnel working at the Experimental Diving Unit (EDU) in Washington, during the late 1950s and updated at the EDU in Panama City,

Astronaut CDR Joseph Kerwin, MC, the first American physician in space, examines fellow crewmember Paul Weitz aboard Skylab during their 28-day orbital mission (1973).



Missions other than war: a Filipino girl receives dental treatment during a medical civic action program (1989).

FL, in the 1980s. Divers throughout the world now use these tables to prevent serious injury and death from the bends.

As we close out the twentieth century, we should take pride in what Navy medical personnel have accomplished in the last century. From turning the ghastly cholera into a treatable disease, to supporting the Marine Corps and the fleet in two world wars, to protecting divers working on the sea floor. Navy medicine has earned its stripes many times over. Who knows what the next hundred years will bring.—JKH

This article is based on a paper by the Editor presented at AMSUS, Anaheim, CA, November 1999.

High Altitude Medicine: Case Report

LT Craig M. Banull, MC, USNR

In August 1997, while training at the Marine Warfare Training Center (MWTC) at Bridgeport, CA, (elevation 6,765 feet), a 40-year-old African American staff sergeant with no known past medical history presented to a field battalion aid station complaining of progressive shortness of breath. Prior to arrival at this training facility, the patient was in normal health, able to run 3 miles in less than 25 minutes at sea level, at Camp Pendleton, CA.

Since beginning his training at MWTC, he noticed a decrease in exercise tolerance causing him to drop out of training evolutions. He reported progressive lightheadedness made worse with exertion. In addition, for 24 hours prior to presentation, he developed sudden, abrupt, substernal, exertional chest pain that did not radiate to neck or extremities. It usually lasted 3 minutes and was relieved with rest. He also denied nausea, vomiting, diaphoresis, or palpitations.

During the week prior to presentation, the patient was experiencing dyspnea upon walking 50 feet, episodic paroxysmal nocturnal dyspnea, 2-pillow orthopnea, but denied lower extremity edema. He also noted an increasing productive cough of greenish sputum. He reported chills but denied fevers and night sweats. He noted normal urinary output despite increasing fluid intake during training. He did report insomnia, anorexia, and nausea that were not related to the chest pain episodes.

The patient had no past medical or surgical history. Pre-military screening showed no evidence of sickle cell trait or disease. He was not taking any prescribed or over-the-counter medications. He denied illicit drug use. Family history was unremarkable for cardiac, pulmonary, or hematologic diseases. He consumed two beers per week and smoked two to three packs of cigarettes per week for 20 years.

His temperature was 36.6° C (97.8° F), blood pressure was 140/80, pulse was 100, respiratory rate was 18, and

Table 1
Laboratory Values Obtained Upon Transfer from Field to MWTC Clinic

Sodium	140.0
Chloride	4.7
Carbon Dioxide	107.0
Bun	24.0
Creatine	0.8
Glucose	84.0
White Blood Count	15.7
Hemoglobin	15.3
Hematocrit	46.3
Platelets	312.0

pulse oximetry was 88 percent on room air. In general, the patient appeared distressed with labored, shallow breathing, but was able to speak in complete sentences. He was alert, oriented x3 and appropriate. His bulbar conjunctiva was injected bilaterally. No sinus tenderness was elicited. Oropharynx was negative for erythema and exudates. His neck revealed no adenopathy or bruits, but radiation of a systolic murmur. His jugular venous pressure was estimated at 6 cm. He had diminished breath sounds bilaterally with poor ventilatory effort. Cardiac exam revealed a nondisplaced PMI and a regular tachycardia with a grade 2/6 systolic early peaking crescendo-decrescendo blowing murmur, loudest at the right upper sternal border with radiation to the carotids bilaterally. He had a normal S1 and S2 with splitting of S2 with inspiration. No S3, S4, gallops, or rubs were noted. Pulses were +2 and symmetric throughout. Abdominal exam demonstrated no pulsatile liver or abdominal-jugular reflux. Hepatosplenomegaly was not evident. Extremities showed no clubbing, cyanosis, or edema. He had a nonfocal neurological exam. Rectal was negative for occult blood.

He was transferred out of the field to the MWTC clinic for further evaluation (Table 1). In addition, the patient underwent a urine dipstick, chest X-ray, and EKG. The following findings were obtained:

1. Urine dipstick was unremarkable except for moderate ketones.

2. Chest X-ray (PA and Lateral) revealed normal heart size. There was evidence of cephalization, and bilateral perihilar prominence without effusions. No infiltrate or pneumothorax was noted.

3. EKG showed normal sinus rhythm with a rate of 80. A normal axis with LVH and early repolarization between V2 and V4 was evident. There were no atrial abnormalities. Otherwise unchanged from prior EKGs.

Table 2
Additional Laboratory Findings at the ER*

White Blood Cell Count	13.1
Neutrophils	67.0
Bands	7.0
Lymphocytes	17.0
Monocytes	7.0
LDH	1321.0
Creatine Kinase	232.0
MB Fraction	0.9

*Arterial Blood Gas not obtained

Table 3
Differential Diagnosis

1. Pulmonary Edema:	
Cardiogenic	Left-Sided Congestive Heart Failure
	Rule-out: Myocardial Infarction or Valvular Dysfunction
Noncardiogenic	High Altitude Pulmonary Edema
2. Atypical/Community Acquired Pneumonia	
3. Acute Mountain Sickness	
4. Pulmonary Emboli (multiple)	

The patient was then given ASA 325 mg and oxygen by facemask at 4 liters per minute and transferred to a local civilian ER. While en route, he began to experience subjective relief of his shortness of breath, and this coincided with a rise in SaO2 to 98 percent. See Table 2 for additional laboratory findings at the emergency room. The differential diagnosis is shown in Table 3.

Treatment Course

In the ER, the patient received Acetazolamide 250mg PO, Cefazolin 1gm IV, and Furosemide 20mg IV, and was admitted to the CCU where he had an initial diuresis of 1500cc. Serial enzymes and EKG ruled out myocardial infarction. No arrhythmias were noted. Transthoracic echocardiogram revealed normal left ventricular systolic function, mild LVH without diastolic dysfunction. A bicuspid aortic valve with an echogenic immobile cusp was visualized. There was mild aortic insufficiency with a transvalvular velocity of 3 meters-per-second, corresponding to a gradient of 30 to 40 mmHg. Gram stain and culture of sputum were unremarkable. Followup CXRs showed clearing of edema and hilar fullness. Over the next 72 hours, his condition improved significantly. The patient was able to ambulate without shortness of breath or desaturation. He was discharged on day 3 with a 10-day course of biaxin for treatment of bronchitis. The final diagnosis was moderate severity, noncardiogenic pulmonary edema secondary to high altitude, High Altitude Pulmonary Edema (HAPE,) in a patient with a bicuspid aortic valve and concomitant bronchitis.

Table 4*
Severity/Classification of HAPE

Grade	Symptoms	Signs	Chest Film
Mild	-Dyspnea on exertion -Dry cough -Fatigue while moving uphill -Localized rales, if any	-HR (at rest) <90-100 -RR (at rest) <20 -Dusky nailbeds	-Minor exudate involving less than 25 percent of one lung field
Moderate	-Dyspnea -Fatigue on walking -Raspy cough -Headache -Weakness -Anorexia	-HR 90-100 -RR 16-30 -Cyanotic nailbeds -Rales present -Ataxia may be present	-Some infiltrate involving 50 percent of one lung or smaller areas of both lungs
Severe	-Dyspnea at rest -Productive cough -Orthpnea -Extreme weakness cyanosis	-Bilateral rales -HR>110 -Facial and nailbed -Ataxia -Stupor -Coma -Blood-tinged sputum	-Bilateral infiltrates 50 percent of each lung

Modified from Hultgren HN. High altitude pulmonary edema. In: Staub NC, ed. *Lung Water and Solute Exchange.* New York: Dekker, 1978, as published in high-altitude medicine. In: Auerbach PS, ed. *Wilderness Medicine: Management of Wilderness and Environmental Emergencies.* 3rd ed. St. Louis: Mosby; 1995:1-37
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Discussion

Today, altitude illnesses have an increasing incidence. This is attributed to nonacclimitized individuals quickly reaching high altitude sites such as occurred with this Marine training in the Sierra Nevadas of California. Physicians must be increasingly aware of this problem in such a setting. For any medical officer, especially those serving with the FMF, knowledge of the pathophysiology, history of presentation, and treatment is paramount to preserving the combat readiness of our troops.

Altitude illnesses can be classified into three different subgroups, Acute Mountain Sickness (AMS), High Altitude Pulmonary Edema (HAPE), and High Altitude Cerebral Edema (HACE), each more severe than the other. The underlying pathophysiologic process is the same for all.(*1*)

The staff sergeant's presentation was most consistent with HAPE. Symptoms usually appear within the first 3 days of ascent at altitudes greater than 8,000 feet.(*1*) It has a mortality rate ranging from 11 percent to 44 percent according to various studies. Risk factors include rapid ascent, strenuous exertion upon arrival at altitude, obesity, male gender, and congenital absence of the right pulmonary artery, and proximal interruption of a pulmonary artery.(*5*)

In a high altitude environment, the patient's hypoxia drives the physiologic responses, which leads to altitude illness. The low barometric pressure causes a low alveolar oxygen tension. Normally, when the PaO2 decreases to less than 60 mmHg, the carotid and aortic bodies respond to cause an increase in the minute ventilation in an attempt to increase the PaO2. This in turn leads to hypocapnia, leading to a respiratory alkalosis. This is known as the hypoxic ventilatory response. Those individuals who have a decreased hypoxic ventilatory response (potentially secondary to upper respiratory infection, underlying pulmonary or cardiac disease) are at a higher risk for developing HAPE.(*1,3*)

An antidiuresis also occurs with a fluid shift from the intravascular to the intracellular spaces. This is thought to be due to the ATP-dependent sodium pump failing. This is further compounded by dehydration from physical activity, environmental stressors such as UV exposure and temperature extremes, and decreased oral intake. In addition,

pulmonary vascular resistance increases secondary to vasoconstriction, which leads to overperfusion of the capillary network. It has been shown in animal models that this vasoconstriction is not uniform but instead patchy, causing a segmental ventilation/perfusion mismatch. Higher capillary pressures locally can cause damage to the capillary wall releasing protein and RBCs into the alveoli space.(*1,2*)

As in this case, specific symptoms and signs must be ascertained before the diagnosis of HAPE can be made. The Lake Louise Symposium constructed the following diagnostic criteria. First, there must be exposure to a high altitude. Second, of the following symptoms, at least two must be present: chest tightness or congestion, weakness or decreased exercise performance, dyspnea at rest, or cough. Third, of the following signs, at least two must be present: tachycardia or tachypnea, central cyanosis, or rales or wheezing in at least one lung field (usually right middle lobe).(*2,4*) Table 4 shows severity/classification of HAPE.

Treatment

In a high altitude environment, the diagnosis of HAPE must be readily considered when a patient has any of the above mentioned signs and symptoms. It is crucial that medical care be instituted quickly and efficiently. Warm the patient to decrease the chances of hypothermia by removing cold, damp clothes and administer 4-6 L/min oxygen. It is recommended to descend to a level below 3,000 feet above sea level. In a field setting, nifedipine and lasix have been utilized for decreasing pulmonary vascular resistance and promoting diuresis, respectively. The use of hyperbaric bags has been utilized too. However, despite our best technological advances in the field, the ultimate therapy is descending to sea level.(*3-5*)

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Military Recruit Healthcare Symposium 2000

The Military Recruit Healthcare Symposium 2000 sponsored by Naval Hospital Great Lakes will be held 25-29 Apr 00 at the Chicago Hyatt Regency O'Hare near O'Hare International Airport. The focus of the symposium is the exchange and exploration of medical-dental and women's health issues involving military recruits and trainees. The symposium is for all healthcare providers, researchers, support personnel, and others involved or interested in recruit and training medicine. Agenda to be announced.

All wishing to give an oral presentation should submit an abstract summarizing presentation content. Topics will be limited to military recruit medical, dental, and women's health issues, innovations, and research. Not all personnel submitting abstracts will be selected to present orally.

Submit abstracts to the Director of Fleet Medicine, Naval Hospital Great Lakes, IL. Speakers selected to present must also submit a current curriculum vitae and lecture objectives to facilitate the awarding of CME/CEUS).

For more information call the Director Fleet Medicine (847) 668-2616/3629 or DSN 792-2616/3629, or consult the Naval Hospital Great Lakes Website: http://greatlakes.med.navy.mil

Book Review

***We Band of Angels* by Elizabeth M. Norman**
Random House, New York, 327 pp, 1999

Dr. Elizabeth Norman, a nursing professor at New York University and acclaimed nurse historian, writes her second book about nurses in combat. Her first explored the account of 50 nurses in Vietnam. *We Band of Angels* explores the plight of Army and Navy nurses during the Japanese invasion of the Philippines and as prisoners of war. It is a gripping historical narrative that pulls together interviews, diaries, and official accounts of several dozen World War II nurses who served during the entire Pacific campaign. It is a tale of heroism, sacrifice, and teamwork told from a medical perspective. Extraordinary women like Navy nurse Mary Rose Harrington and Margaret Nash, and Army nurses Josie Nesbit and Maude Davidson, among others, tell their stories.

A day after Pearl Harbor, the Japanese began their invasion of the Philippines. General Douglas MacArthur's outnumbered and outgunned American and Filipino forces were forced to give ground and retreat to the narrow Bataan peninsula. Those who did not surrender on Bataan in April 1942 fled to the island of Corregidor in Manila Bay, where they held out for another month. With them, were a number of Army nurses and a single Navy nurse. The other 11 Navy nurses from the Canacao Naval Hospital remained in Manila to be captured in January when Japanese forces entered the undefended city.

We Band of Angels describes the fighting on Bataan and work of the jungle hospital where Army medical teams treated several thousand sick, wounded, and dying soldiers. The nurses recount gruesome combat wounds, amputations performed without ether and other anesthetics, and the constant bombing by Japanese planes. However, even more devastating was the disease and hunger that wore down the American and Filipino defenders. The nurses describe how tropical diseases like malaria, dysentery, and dengue fever overwhelmed both soldiers and medical staff alike. They also discuss their fears of being captured and relate how some were selected to be evacuated to Corregidor and how others remained to face internment at the hands of a Japanese Army with a reputation garnered during the 1937 Rape of Nanking.

General Jonathan Wainwright, who assumed command following MacArthur's departure, eventually had to order nurses to leave just prior to his surrendering the Philippines. With a very strong tradition of protecting the well-being of their patients, these military nurses were reluctant to abandon those they had an obligation to protect.

For over 70 Army and Navy nurses who remained behind, the ordeal was just beginning. They would face over 3 years as prisoners of war in the internment camps of Santo Tomas and Los Banos. What held them together in the face of malnutrition and disease were honor, courage, and a dedication to their profession. There were patients to care for and each day they performed their duties despite the lack of medicine and instruments.

Then food became scarcer and treatment at the hands of the Japanese worsened when the tide of war turned. As women, they describe both the psychological toll and the physiological changes captivity wrought within their own malnourished and diseased bodies.

Because they were nurses and had duties to perform, these women survived and eventually were liberated by MacArthur's forces. Newly freed, the nurses suddenly confronted a new world of medicine that had changed drastically in the 3 years they were absent. Many had never heard of penicillin and other military innovations like C-rations and the new term for the soldier in the field—"GI." They returned to the United States as heroes and were decorated for combat heroism.

We Band of Angels is a great read and gives those in military medicine a renewed sense of pride, particularly in the Navy and Army Nurse Corps. The book is richly illustrated with photographs from many sources including our own Bureau of Medicine and Surgery. Historian and author Stephen E. Ambrose, who has written several best-selling books on World War II, including *Citizen Soldier* and *The Victors*, has lauded the "Battling Belles" of Bataan and the fine work of Elizabeth Norman.

—LT Y. H. Aboul-Enein, MSC, is Plans, Operations and Medical Intelligence Officer, Naval Hospital Great Lakes, IL.

Navy Medicine 1956

BUMED Archives

Hospital corpsmen prepare a crewman suffering acute appendicitis for medevac from USS *Scanner* (YACR-5).

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